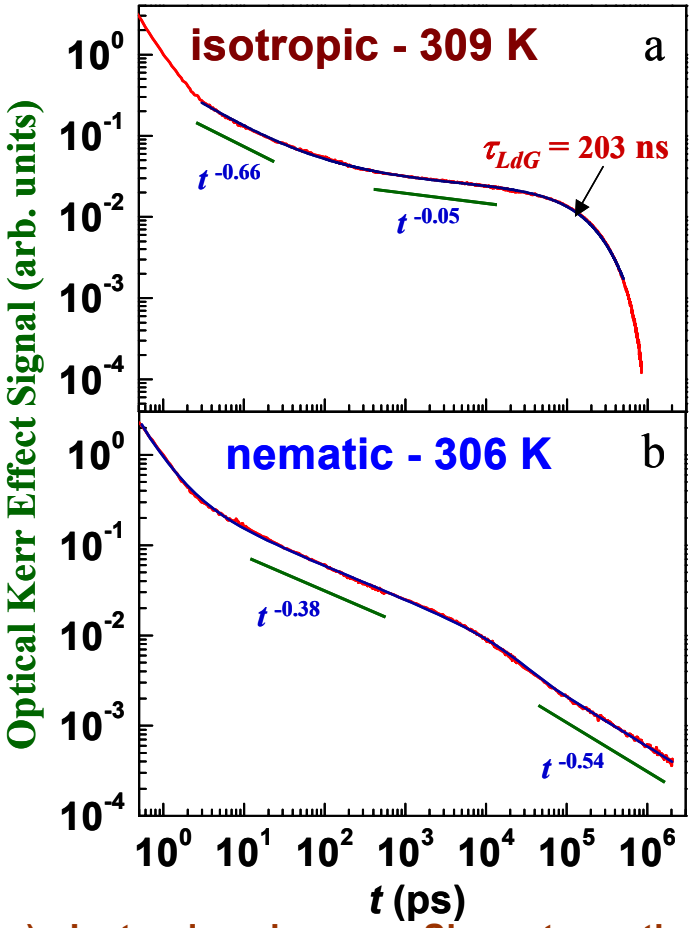
Ultrafast to Slow Orientational Dynamics of Aligned Nematic Liquid Crystals

Michael D. Fayer, Stanford University, DMR-0088942

Ultrafast to Slow Non-Linear Optical Experiments are used to investigate changes in dynamics when a liquid crystal goes from disorder to order. In spite of their technological importance, the dynamics of liquid crystals are not understood. Liquid crystal molecules (nematogens) are disordered in the high temperature isotropic phase, but they become ordered in one direction in the lower temperature nematic phase. **For the first time, dynamics in the nematic phase have been measured.** The experiments spanning hundreds of femtoseconds to microseconds (7 decades of time) show dramatic differences between the nematic and isotropic phases. Only the longest time portion (>100 nanoseconds) is understood theoretically in the isotropic phase. There are no theoretical descriptions of the short time dynamics in the isotropic phase and no description of dynamics at all for the ordered nematic phase. The new experiments provide the base for detailed understanding of these technologically important materials.

Jie Li, Irene Wang, and M. D. Fayer, J. Phys. Chem. A submitted (2004).



a) Isotropic phase. Slowest portion exponential. Two shorter time power laws. b) Nematic phase. Slowest portion power law. A short time power law. Note log-log scale.

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Education: Two graduate students (Hu Cang and Jie Li) and a postdoc (Irene Wang) contributed to this work. Hu Cang is just completing his Ph. D, and will soon begin a post doc. He is headed toward an academic position in the United States. Jie Li is continuing her Ph.D. studies in Chemistry. Irene Wang has just taken an academic position at Université Claude Bernard in Lyon, France in condensed matter and nanostructure physics. A theoretical collaboration on this work has begun with Professor Hans C. Andersen of the Stanford Chemistry Department, and new theoretical student, David Spry, is undertaking the development of a theoretical understanding of the experiments.

Outreach: The PI developed a Power Point slide show for teaching introductory chemistry. The PI had discussions with a new high school chemistry teacher, Hailey Moilanen, Freemont Union High School District, Sunnyvale, California, on preparation of class material. The power point slide show was provided to Mrs. Moilanen.